THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[SIXTH SERIES.]

No. 50. FEBRUARY 1892.

XVII.—*The Earthworms of the Vienna Museum.*

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[Plate VII.]

Prof. Claus has been so good as to let me examine the collection of earthworms preserved in the Vienna Museum, which includes the forms described by Schmarda in his 'Neue wirbellose Thiere' *, as well as a number of unnamed species from various localities.

Schmarda's species have been so long a mystery to the students of this group of Annelids, that I am very glad to be able to identify them.

"*Hypogæon heterostichon.*"

Schmarda's diagnosis of the species runs as follows:—

"Series setarum in dorso octo, binæ in antica parte convergentes, in postica divergentes."

Clearly, therefore, it should not be placed in the genus *Hypogæon* as defined by Savigny; for that genus has nine setæ per segment, the unpaired seta being dorsal in position. Such a character is quite sufficient to distinguish a genus, though no doubt the existence of this ninth seta requires further proof.

* 'Neue wirbellose Thiere &c.,' Leipsic, 1861, Bd. ii.

"*Hypogæon heterostichon*" is not a species of Perrier's genus *Titanus**, which Rosa has recently shown † to be identical with *Geoscolex* of F. S. Leuckart ‡, as might be inferred from Schmarda's diagnosis, but belongs to the genus *Anteus*. There are three or four specimens of this species in the collection from Ecuador and the Cordilleras.

It appears to differ from *Anteus gigas*, the only species of the genus at present known, and may be described as

(1) **Anteus hetorostichon** (Schm.).
(Pl. VII. figs. 1 and 7).

Hypogæon heterostichon, Schmarda, Neue wirb. Thiere, Bd. i. Hälfte ii. p. 12.

The species is about 10 inches or so in length, with a diameter of 12 millim. anteriorly.

The colour (in spirit) is yellowish white anteriorly and bluish posteriorly; the blue colour is due to the thinness of the integument and the dark colour of the intestinal contents. There appears in fact to be no pigment in the skin at all. The setæ have precisely the arrangement which characterizes the other species, as is indeed set forth in Schmarda's diagnosis quoted above.

The *setæ* present the form which is illustrated in fig. 7; they are perhaps rather straighter (less curved) than in many other earthworms; fig. 7 *c* represents the free extremity of the seta more highly magnified; it is seen to be covered with faintly marked ridges. The genital setæ, which occur upon the clitellum, are rather more than twice as long as the ordinary setæ; the proportions are as indicated in figs. 7 *a* and *b*: *a* is of course a clitellar seta; the basal portion of this seta is curved, the rest of the shaft is nearly straight; at the free extremity the ridges are very strongly marked. The setæ appear to be precisely like those of *Anteus gigas* § and of *Rhinodrilus* ‖.

The nephridiopores, which commence upon the first setigerous segment, are placed as in the genus *Anteus*, in front of

* "Mémoires pour servir à l'histoire des Lombriciens terrestres," Nouv. Arch. Mus. t. viii. p. 57.

† "Sul *Geoscolex maximus*, Leuck.," Boll. Mus. Zool. Torino, vol. iii. no. 40.

‡ "*Geoscolex*, Leuck., ein neues Geschlecht von Ringwürmern," Zool. Bruchstücke, Heft ii.

§ "Descriptions of Earthworms.—VI. On *Anteus gigas*," Perrier, Notes Leyden Mus. vol. xiii. p. 77; Perrier, *loc. cit.* pl. i. figs. 10, 11.

‖ "On the Structure of a new Genus of Lumbricidæ (*Thamnodrilus Gulielmi*)," Proc. Zool. Soc. 1887, p. 154. This worm is really a *Rhinodrilus*.

the outermost seta of the dorsal couple; this is of course more apparent when the setæ diverge posteriorly.

The clitellum is developed in one specimen and occupied segments xv.–xxiii. There are two pairs of calciferous glands in segments xii. and xiii. These glands, as in *Urochæta*, stand out from the walls of the œsophagus instead of being attached to them along their whole length, as in most earthworms; they are subconical in form, the apex being directed away from the gut. A large branch arising from the dorsal vessel on each side supplies the anterior glands, entering them at the apex.

The principal difference, however, which this species shows from either of the other two species is in the sperm-sacs; instead of being represented by a single pair of long "tongue-shaped" organs, the sperm-sacs of *Anteus heterostichon* are two pairs of small bodies attached to the anterior septa of segments xi. and xii. They appear, in fact, to resemble those of *Anteus gigas*.

It is noteworthy that this species, like the other two, possesses no spermatheca; the absence of these structures seems to characterize the genus.

The nephridia fall into two series; up to the twelfth segment they have an exceedingly long muscular duct, which is shown by Horst in his figure * of the nephridium in *Anteus gigas*. I traced a delicate tube passing from this tuft of tubules forwards into the segment in front, where it doubtless ends in a funnel. Perrier's figure † of the nephridium and his description give an erroneous idea of the structure. The description runs as follows:—"Ces organes présentent d'ailleurs dans ces deux anneaux et dans les sept suivants qui font également partie de la ceinture un calibre plus considérable. Au lieu d'être pelotonnés comme chez la plupart des Lombrics, ils sont simplement un peu flexueux; leur calibre est suffisant pour qu'on puisse les injecter facilement par leur orifice extérieur, qui est lui-même fort apparent sur la ceinture. Chacun d'eux est terminé par une sorte de houppe formée par une série de replis membraneux implantés sur sa portion terminale libre. Cette houppe constitue le pavillon vibratil au milieu duquel s'ouvre le canal." This description implies that the convoluted tuft of tubules is really a large funnel.

Neither Perrier nor Horst noted that the posterior nephridia are different in structure from the anterior series. After the twelfth segment (in the present species) the nephridia still

* Notes Leyd. Mus. xiii. pl. vi. fig. 3.

† *Loc. cit.* pl. i. fig. 14.

have a large terminal sac; but this lies along the transverse axes of the body in close contact with the septa and is furnished with a cæcum which lies on the distal side of the external pore.

Perrier has indeed remarked that the posterior nephridia of *Anteus gigas* are less in calibre than the anterior and are attached by a membrane not represented in the anterior series; but he says nothing of the cæcum (supposing it to exist in that species).

It is frequently the case in this family of earthworms (Geoscolecidæ) that the anterior nephridia differ in structure from the posterior. In *Rhinodrilus Gulielmi* * precisely the same differences exist as in the present species.

The present species of *Anteus*, like the other species of the genus and like so many other earthworms, has several specially thickened septa lying in the anterior region of the body. In *Anteus heterostichon* there are four of these immediately following the gizzard and separating segments vi./vii., vii./viii., viii./ix., ix./x.; behind these is another, thinner, septum which largely covers the septum in front, just as these cover each other successively in the way that Perrier has described.

Species of Anteus.

Is the above species really distinct from *Anteus gigas* described by Perrier, and more recently by Horst? I am convinced that it *is* distinct, and, moreover, I believe that Horst's species is not the same as either Perrier's or the one that I have just described.

The points of difference between *Anteus heterostichon* and *Anteus gigas* are of course to be found mainly in the divergence of the setæ posteriorly and in the commencement of the posterior set of nephridia in the thirteenth instead of the twentieth segment in the latter species. There can be no confusion as to these points, as Perrier's description is perfectly clear. With regard to the setæ he says (p. 52), "Les soies sont disposées, comme chez le Lombric ordinaire, en quatre rangées de paires, deux rangées sont franchement ventrales, deux latérales. Ces rangées sont constamment parallèles d'une extrémité à l'autre du corps, et les soies de chaque paire sont toujours très-rapprochées l'une de l'autre."

Dr. Horst considers that the species which he investigated is *Anteus gigas*. But in that form, as in *Anteus heterostichon*

* Beddard, *loc. cit.*, woodcuts figs. 5 and 6.

and in *Geoscolex maximus*, "the setæ in the posterior segments have also a tendency to separate."

The *clitellum* also is less extensive than in *Anteus gigas*, though this point is of less importance and mainly due to a difference in the state of maturity in the two specimens. Finally it comes from a different locality *.

The following is a definition of the three species. I reserve the generic definition until the next section.

1. *Anteus gigas*, Perrier.

Anteus gigas, Perrier, Nouv. Arch. Mus. t. viii. p. 50.

1 metre 16 centim. in length. Setæ strictly paired. Six strong infundibuliform septa following gizzard. Clitellum occupying segments xiii.–xxix. (?) Nephridia changing in structure in the twentieth segment.

Hab. Cayenne.

2. *Anteus Horsti*, Beddard.

Anteus gigas, Horst, Notes Leyd. Mus. vol. xiii. p. 77.

86 centim. in length. Colour (in spirit) bluish green, darker dorsally; clitellum brownish. Setæ paired, becoming separated slightly from each other posteriorly. Clitellum occupying segments xiv.–xxxii. Three pairs of calciferous glands; six strong septa following gizzard.

Hab. Brazil.

3. *Anteus heterostichon* (Schmarda).

Hypogæon heterostichon, Schmarda, Neue wirb. Thiere, Bd. i. Hälfte ii. p. 14.

25 centim. in length. Colour (in spirit) whitish brown, *i. e.* no pigment in skin or very little. Clitellum occupying segments xv.–xxiii. Setæ strictly paired anteriorly, widely divergent posteriorly. Two pairs of calciferous glands. Four strong septa following gizzard. Posterior nephridia from those of segment xiii. different in structure from anterior.

Hab. Ecuador and the Cordilleras.

Affinities of Genus Anteus.

Vaillant has recently proposed to unite the genera *Anteus*

* I do not mention the ornamented setæ, on the assumption that they also exist in *Anteus gigas*; and yet Perrier, who discovered these setæ in *Rhinodrilus*, says nothing about their existence in *Anteus*. Indeed he remarks on p. 145 of his memoir, when giving briefly the characters of the genera, that in *Anteus* the setæ are all alike, i. e. *not* modified upon the clitellum.

and *Microchæta* *, a proposition with which I cannot agree. No doubt there is a close affinity between *Anteus* and *Microchæta*; but the points of difference are numerous and, collectively at least, of considerable importance. Thus in *Microchæta* the setæ are not ornamented, even those of the clitellar segments; the nephridia differ from those of *Anteus*; the single calciferous gland is a dilatation of the œsophagus; the sperm-sacs are not at all like those of *Anteus*; and, finally, the spermatheca of *Microchæta* are a number of small sacs situated behind the segments which these structures usually occupy. Benham has suggested † that similar spermathecæ may have been overlooked by Perrier in *Anteus*; they do not, I am convinced, exist in that genus. With *Rhinodrilus*, however, *Anteus* shows such close resemblances that they amount, in my opinion, to generic identity.

Until the publication of Horst's paper upon *Anteus* and my own upon *Rhinodrilus Gulielmi* the two genera appeared to be very different. We now know that the ornamentation of the setæ and the difference between the ordinary setæ and the clitellar setæ are the same in both genera and that the nephridia have the same relations and structure (there being an anterior and posterior series differing by the presence or absence of a cæcum to the duct), and that the genitalia show no differences ‡. The clitellum in *Rhinodrilus Gulielmi* is nearly coextensive with that of *Anteus heterostichon*; indeed that species of *Rhinodrilus* and *Anteus heterostichon* link together the more divergent forms of either genus. The only points in which the two genera differ are:—

(1) The presence of a greater number of calciferous glands; and
(2) The presence of an elongated prostomium in *Rhinodrilus*.

As to the first point, it may be remarked that the number of pairs of calciferous pouches is not the same in all species of *Rhinodrilus*; there are six pairs in *Rhinodrilus Tenkatei* and *Rhinodrilus Gulielmi*, eight pairs in *Rhinodrilus ecuadoriensis* ‖; we know nothing about these glands in *Rhinodrilus*

* "Annelés," in 'Suites à Buffon,' t. iii. p. 184.

† "An Attempt to Classify Earthworms," Quart. Journ. Micr. Sci. vol. xxxi. p. 265.

‡ Except perhaps in the presence or absence of spermathecæ. In *Anteus* spermathecæ have never been found: in *Rhinodrilus paradoxus* Perrier did not meet with them, but he examined only one individual; I found them to be occasionally wanting in *Rhinodrilus Gulielmi*.

‖ Benham, *loc. cit.* p. 253.

paradoxus. If the number of the glands were constantly the same the character would have more importance.

With regard to the prostomium, I quite agree with Perrier that the modifications of this alone are not sufficient to base generic characters upon. In view of the close resemblances in the clitellum, setæ, nephridia, and genitalia, between *Rhinodrilus Gulielmi* and *Anteus heterostichon*, and the considerable differences between the several species of each genus, it is difficult, I think, to maintain the two genera.

Anteus also shows resemblances to *Geoscolex* which nearly, if not quite, amount to generic identity.

The divergence of the setæ posteriorly which occurs in *Anteus heterostichon* is a new character in *Anteus*, but is one which characterizes *Geoscolex*—at least *Geoscolex maximus*; another character of *Geoscolex maximus*, which I shall refer to again in describing that species, is shared by *Anteus* and *Rhinodrilus*—that is, the ornamentation of the setæ; the clitellar setæ, it is true, are not different from the rest, but neither are they in *Anteus gigas* (?). *Geoscolex*, however, is distinguished by the long sperm-sacs, of which there is only one pair, by the muscular atrium, by the ventral nephridiopores, and the absence of any specialization in the nephridia of the anterior segments, and by the single pair of calciferous glands. In the meantime, therefore, I should prefer to retain the genus *Geoscolex* as distinct, but to merge *Anteus* and *Rhinodrilus* *.

(2) Geoscolex maximus, F. S. Leuckart.
(Pl. VII. figs. 2 and 8.)

Geoscolex maximus, F. S. Leuckart, Zool. Bruchstücke, Heft ii.
Titanus brasiliensis, Perrier, Nouv. Arch. Mus. t. viii. p. 57.

There is a single specimen of a worm which I refer to this species; it is labelled "*Lumbricus paucisetis*," and was collected near the river Patia, in Colombia.

The specimen measures 26½ inches in length by 18 millim.

* I may mention in connexion with the prostomium (so-called) of *Rhinodrilus* that I have recently investigated a species of *Diacheta* with a similar process, which proves to be an evaginable tube lying in a diverticulum of the buccal cavity just in front of and beneath the brain. Vaillant's account of the prostomium in *Rhinodrilus* agrees with my observations upon "*Thamnodrilus*" and upon the *Diacheta* just referred to. I do not think that the presence of this structure can be regarded as of generic importance in either case; the fact of its occurrence in species of two genera widely removed though certainly belonging to the same family is against regarding this "trompe" as of special importance for systematic purposes.

in diameter at the clitellum; it is of an intense brown colour, almost black, the intersegmental grooves being grey. Perrier does not mention the colour of his specimens.

The only points in the structure of the worm to which I wish to call particular attention are the calciferous glands, which were mistaken by Perrier for a part of the circulatory system; the structure lettered *cœ* in his figure * is really a calciferous gland † of a conical form; a blood-vessel arising from the dorsal vessel enters this gland at the apex, and looks very much as if it were simply continuous with it; however, in the specimen in the Vienna Museum the blood-vessel gives off a branch which ramifies over the surface of the gland before it enters its substance; this does away with the resemblance which the gland bears to a simple enlargement of the vascular trunk which supplies it. In the segment in front of this, *i. e.* the twelfth, is a large body which appears to be in connexion with the calciferous gland. This is really a dilated "heart," and there is another pair equally or nearly equally large in the next segment in front. The condition of this specimen did not permit of a conclusive settlement of this question; but I have been able to get some evidence in favour of this view of the anatomy of the parts.

A portion of the contents of the body lettered H in the drawing (Pl. VII. fig. 2) was extracted and teased in glycerine; it was evidently simply a blood-clot. On the other hand, a portion of the contents of the body, lettered *Ca*, which I take to be a calciferous gland, showed a series of elongated blood-clots which were surrounded by a layer of granular débris; these clots were highly suggestive of the coagulated contents of the blood-spaces which lie in the folds of the calciferous glands of other earthworms; the granular substance round the clots would be in this case the remains of the epithelium. As to the connexion between the calciferous glands of each side and the heart, which Perrier figures, it undoubtedly occurs, though perhaps it is more apparent than real. In the first place there is a septum between the two; they occur in different segments, both being attached to the septum would give an appearance of an actual connexion; there may, however, be a short branch from the heart to the calciferous gland.

The setæ of *Geoscolex* are said by Perrier to possess no interesting peculiarity. I understand by this that he regarded them as similar to those of *Lumbricus*. I find, however (see

* *Loc. cit.* pl. i. fig. 15.

† Dr. Benham informs me that he has come to the same conclusion.

fig. 8), that, as in *Anteus*, the distal extremity of each seta is ornamented by slight ridges with a jagged outline. The setæ present the same character on the clitellum and at the posterior extremity of the body. I may remark that it is not always easy to detect the ornamentation of the setæ. It is not sufficient to strip off a bit of the cuticle and then to examine under the microscope the cuticle and the setæ that have been accidentally detached in tearing it off. The cuticle itself in such a case frequently obscures the markings on the setæ.

The setæ must be picked out one by one; this is quite easy with a large species like *Geoscolex maximus*; when the body is opened the cavities where the setæ are planted are seen to be very large, and the setæ can be readily seized with the forceps and detached.

The nephridia open, as Perrier and Leuckart stated, in front of the ventral setæ; they have a large muscular vesicle.

In the anterior region of the body the nephridial duct passes straight from the tuft of tubules to the external pore; in the hinder region this duct is bent upon itself, but there is no cæcum such as is found in *Anteus*. The nephridia therefore show only the very slightest traces of the specialization into an anterior and a posterior series that is found in *Anteus*. The funnel, as in other earthworms, depends into the segment in front of the one in which the nephridium lies.

The sperm-sacs are long and were doubled upon themselves in the specimen which I examined. The vas deferens where it leaves the sperm-sac runs at first forwards and downwards side by side with the duct of a nephridium; it opens into a large muscular sac which occupies three or four segments and is constricted where it passes through the mesenteries. I did not notice the three bands figured by Perrier* attached to the atrium.

There are, as Perrier has stated, no spermathecæ.

(3) "*Perichæta leucocycla*."

The collection contains a number of individuals labelled with this name. One smallish individual (no. 16) is evidently the type figured by Schmarda. Being quite immature, it is impossible to be absolutely certain whether it is really identical with a large individual measuring 37 inches in length, which has a similar label. So far as it was possible to form an opinion from the arrangement of the setæ (which show dorsal and ventral gaps) and from the general appearance of

* *Loc. cit.* pl. i. fig. 15.

the worm it is identical. "*Perichæta leucocycla*" is therefore the same species as *Megascolex cæruleus*, in spite of the differences of colour shown in Schmarda's figure and in Bourne's *.

The synonymy of the species will therefore stand thus:—

Megascolex cæruleus, Templeton, Ann. & Mag. Nat. Hist. 1845, p. 60.
Perichæta leucocycla, Schmarda, Neue wirbell. Thiere, Bd. i. Hälfte ii. p. 13.
Pleurochæta Moseleyi, Beddard, Trans. Roy. Soc. Edinb. vol. xxx. p. 481.
Megascolex Moseleyi, Vaillant, Annelés, Suites à Buffon, t. iii. p. 67.

"*Perichæta cingulata*," Schm.

The collection contains two specimens, one of which is the type of Schmarda's species. This is sexually mature, so that I can describe its external characters more accurately than has been hitherto done. Vaillant † apparently confounded several species together under the name of *Perichæta cingulata*, as Perrier pointed out; but none of these species are really identical with Schmarda's. It is, in fact, not a true *Perichæta* at all.

I shall refer to it here as

(4) Megascolex cingulatus, Schm.
(Pl. VII. figs. 9–13.)

Perichæta cingulata, Schmarda, Neue wirbell. Thiere, Bd. i. Hälfte ii. p. 14,
Non *Perichæta cingulata*, Vaillant, Ann. Sci. Nat. 1868, p. 225.
Non *Megascolex cingulatus*, Vaillant, Annelés, p. 72.

I refer this worm to the genus *Megascolex* principally on account of the fact that the setæ are not arranged in a perfectly continuous circle round each segment, but are interrupted by dorsal and ventral gaps, as, for instance, in *Megascolex cæruleus*.

The clitellum consists of five segments, viz. xiii.–xvii.; setæ are present upon all these segments, but vary in their numbers on different segments. The first segment of the clitellum, the thirteenth, has a complete circle of setæ marked of course by the same dorsal and ventral gaps as are the rows of setæ upon the pre- and post-clitellar segments. The fourteenth, fifteenth, and sixteenth segments have each three setæ

* "On *Megascolex cæruleus*, Templeton, from Ceylon," &c., Quart. Journ. Micr. Sci. vol. xxxii. pl. vi.

† "Note sur l'Anatomie de deux espèces du genre *Perichæta*," &c. Ann. Sci. Nat. t. x. (1868) p. 225.

upon each side of a median gap. The eighteenth segment has five or six setæ upon each side of the median gap.

Dorsal pores are present, and commence, as in *Megascolex armatus*, between segments v./vi.

The oviducal pores, as in *Megascolex* generally, are double; each pore lies in front of the innermost seta of segment xiv.

The male pores are upon segment xviii. No setæ lie between them; they are placed in the line of the setæ. Each pore is surrounded by prominent lips, and there is a genital papilla in front of and behind each pore; the papillæ in question are upon the boundary-lines between segments xvii./xviii. and xviii./xix.

In Schmarda's figure of the species the clitellum is depicted as commencing with segment xv.; but in the text it is stated to commence after the thirteenth.

When the worm was opened by a median dorsal incision the intestine was partially cut into; otherwise the viscera were uninjured. Five of the intersegmental septa were specially thick and appeared of a brownish colour, the thin septa being bluish or colourless. The first thick septum follows immediately after the gizzard; in front of the gizzard lies the first recognizable septum, which is also rather thick; between this and the septum following the gizzard is a thin septum. The thick septa are bound by numerous isolated muscular strands, which show interference-colours. The number of them appeared to me to be unusually great for so small a worm; they were particularly abundant in the gizzard-segment and in those lying in front of the gizzard.

The alimentary tract presents the usual divisions; the first four segments were occupied by the buccal cavity, pharynx, and a part of the œsophagus. The buccal cavity was largely everted; the pharynx did not present the compact appearance which is usual in this organ; the muscular fibres forming its dorsal wall and connecting it with the parietes were greatly broken up into bundles running chiefly in a longitudinal direction; this was no doubt due to the protrusion of the buccal cavity and the consequent pushing forward of the pharynx; the fifth segment was entirely occupied by the œsophagus—the gizzard lying in the two following; the fifth segment is not bounded posteriorly by a distinct septum, but the sixth and seventh are separated by a septum. The forward position of the gizzard and the presence of a septum dividing the two segments in which it lies are characteristic of the genus *Megascolex*, at least these features are not met with in *Perichæta* (*s. s.*). The terminal section of the œsophagus is exceedingly narrow, and the large intestine suddenly begins

in the fifteenth segment, its calibre being three or four times that of the œsophagus.

The dorsal blood-vessel is single. The cerebral ganglia lie opposite to the furrow separating the first from the second segment; they may possibly have been pushed forwards with the everted buccal cavity.

There is only a single pair of spermathecæ, which in compensation are very large; they occupy nearly the whole of the available space in segment ix., and indeed they materially encroach upon the cavity of segment viii., of course pushing the septum which divides the two segments in front of them. Each spermatheca (fig. 10) consists of a large thin-walled sac (*sp*) filled with hard coagulated yellowish matter; this communicates with the exterior by a duct which is very thick-walled and has a metallic yellow colour; connected with the duct is an equally thick-walled, somewhat oval diverticulum (*d*), which becomes constricted just before joining the spermathecal duct; at this point it is furnished with two subsidiary diverticula (*d'*); each of these small diverticula is really double and consists of two globular sacs (fig. 11, *d'*) opening by a common duct. These minute sacs, less than a pin's head in size, are opaque yellow and contain sperm. The spermathecal duct after it is joined by the wide diverticulum becomes somewhat dilated and opens on to the exterior just below the mesentery dividing its segment from the eighth. So far as I could make out there appeared to be some slight variation in the number of the small pouches belonging to the diverticula; but as the specimen is a unique one I am not in a position to give details the recording of which would have necessitated the destruction of the specimen. The *sperm-sacs* occupy segments x. and xi.; I am not quite certain whether they reach the twelfth segment. The *atria* have the lobate form so characteristic of the Perichætidæ, but they are nevertheless rather unusual in one point of structure: in all atria of this kind of which I am acquainted with from figures or description or from my own dissections the muscular duct which leads to the exterior comes off from about the middle of the glandular mass, and is generally comparatively short and curved into a horseshoe-shaped form; in *Megascolex cingulatus* the atria lie on either side of the gut, to which they are closely attached; more generally one finds the atria adherent to the ventral parietes. They are long and narrow, and extend from the eighteenth to the twenty-fourth segment; although long and narrow, they have not the tubular form found in the atria of *Acanthodrilus* and other genera; they are composed of numerous lobules of various sizes. The duct, however, comes off from the ante-

rior end of the atrium in the eighteenth segment; it is rather long and coiled, and opens on to the exterior without any terminal dilatation. The structure of the atria is thus very interesting, inasmuch as they present us with characters intermediate between the "lobate" and "tubular" form of atrium. As both forms of atria are met with in the Perichætidæ, though the lobate is the more common type, the intermediate condition is required.

Close to the point where the atrium perforates the body-wall on its way to the exterior is a sac containing penial setæ. These setæ differ (see fig. 13) from those of *Megascolex armatus*, the only other species of the genus in which they have been hitherto figured. They are sharply bent at the extremity, which is beset for a short distance with minute denticulations.

Corresponding to the papillæ which I have referred to in describing the external characters are four round white glands.

"*Perichæta brachycycla*," Schm.

This is also a *Megascolex*; there is nothing but the colour to distinguish it from *Megascolex cingulatus*, since the clitellum was undeveloped, and since I have not been able to compare the internal organs. As there is the colour difference I shall for the present assume the distinctness of the species, and rename it

(5) **Megascolex brachycyclus** (Schm.).

Perichæta brachycycla, Schmarda, Neue wirbell. Thiere, Bd. i. Hälfte ii. p. 14.
Megascolex brachycyclus, Vaillant, Annelés, p. 88.

The characters upon which Schmarda relied to distinguish the species from the others described by him was the form of the setæ; it is now known that the form of the setæ cannot be relied upon for the discrimination of the species of *Perichæta*. This is certainly my own experience, and Prof. Bourne, who has examined a large number of species, remarks that, except in special cases, the shape of the setæ "is of little use for classificatory purposes."

The dorsal and ventral gaps in the circles of setæ are not perhaps so well marked as in *M. cingulatus*.

The first dorsal pore is, as in that species, between segments v./vi.

The oviducal pores are double.

The male pores are upon the eighteenth segment; in front of and behind each of them is a genital papilla; these lie, as

in *Megascolex cingulatus*, upon the intersegmental grooves xvii./xviii. and xviii./xix., but appear to be rather different in position, in so far as they are not precisely above and below the genital pore, but both outside of it.

(6) Perichæta viridis, Schm.

Perichæta viridis, Schmarda, Neue wirbell. Thiere, Bd. i. Hälfte ii. p. 13.
Megascolex viridis, Vaillant, Annelés, p. 87.

Beyond stating that this species is a true *Perichæta* I have no further observations to offer about it. None of the specimens were mature, and no distinctive characters could therefore be drawn up.

(7) Pontoscolex arenicola, Schm. (Pl. VII. figs. 3 and 6.)

Pontoscolex arenicola, Schmarda, Neue wirbell. Thiere, Bd. i. Hälfte ii. p. 11 (in part).
Pontoscolex arenicola, Vaillant, Annelés, p. 198 (in part).

Under the same name Schmarda has confounded two perfectly distinct species, which should perhaps be referred to two distinct genera. As I have no means of knowing which specimen served as the type of the species, I shall regard those individuals with a clitellum consisting of eight segments as representing the species *Pontoscolex arenicola*, the others I shall call *Diachæta littoralis*. They have all the same habitat, occurring upon the seashore in the neighbourhood of Kingston and Port Royal, in Jamaica.

I suggested myself* a short time since that *Pontoscolex* might prove to be *Pontodrilus*, which I have received from Bermuda, where it is also found upon the seashore. This supposition proves to be incorrect. The genus is in fact, as Schmarda's figure would lead one to believe, identical with *Urochæta*; one of the two species at least is referable, in my opinion, to that genus. The others, those with a more extensive clitellum, may perhaps be more suitably placed in Benham's genus *Diachæta*.

Schmarda's diagnosis of the genus is as follows :—

"Quatuordecim series setarum alternas binas. Clitellum. Maricolæ."

In the figure illustrating this species the clitellum appears to be shown in a very unusual position, *i. e.* nearer to the posterior than to the anterior extremity. It is true that it is

* "Abstract of some Investigations into the Structure of the Oligochæta," Ann. & Mag. Nat. Hist., Jan. 1891, p. 96.

not lettered as clitellum; but no other structure is shown in the drawing which could be supposed to be the clitellum. And Schmarda states in the text that the clitellum is usually situated behind. The structure which Schmarda has mistaken for a clitellum is really nothing of the kind; it is formed (fig. 3 *a*) by a group of segments of a somewhat tumid appearance which project beyond the general surface of the body, such as Fritz Müller first described * in *Urochæta corethrura*. This remarkable point of similarity first directed my attention to the probable identity of *Pontoscolex* and *Urochæta*.

The clitellum, as a matter of fact, is anterior in position. Schmarda noticed that this was the case with some specimens. The error into which he fell is to be accounted for by the fact that in the specimen figured, as in many of those collected by him, the clitellum was not developed. In those individuals in which it is developed it occupies eight segments commencing with xv. Its extent therefore is precisely that of *Urochæta*, or, as it must now undoubtedly be called, *Pontoscolex corethrurus*. Schmarda counts seven setæ only in each segment, which alternate in position in successive segments from the very first. This enumeration is inaccurate; there are undoubtedly eight setæ per segment on most of the segments; occasionally on some of the posterior segments of the body I could only find seven, but this is most probably merely due to the loss of one seta. As to the alternation, this only occurs in some of the specimens; perhaps as this fact is the first distinctive point mentioned in the description of the genus I should refer to that genus the individuals which I describe later as *Diachæta littoralis*. As, however, that fact is not referred to in the description of the *species*, and as the figure seems to me to be a little more like the individuals possessing a clitellum of eight segments, I think that the name "*arenicola*" should be applied to them.

In this species, then, the setæ do not alternate from the very beginning; upon the first few segments (I am not certain how many) they are strictly paired; the two setæ of each pair are quite close to each other. In this the species resembles *Pontoscolex corethrurus*. But, unlike what is found in that species, the setæ are ornamented, as in *Rhinodrilus*, with a series of curved ridges. In *Pontoscolex corethrurus* some of the setæ are ornamented, viz. those upon the clitellum; in *Pontoscolex arenicola* the clitellar are also ornamented, but they only differ from the setæ of the preclitellar

* "Description of a new Species of Earthworm," Ann. & Mag. Nat. Hist. vol. xx. 1857, p. 13. See also my own observations upon the same structure in the same journal for January 1891, p. 95.

segments in their greater size. The posterior setæ have the same irregular quincuncial arrangement which occurs in *Pontoscolex corethrurus*; many of them are large; they vary in fact in size, but are never ornamented.

With regard to internal structure this species shows certain differences from *Pontoscolex corethrurus*; but they are not, in my opinion, sufficient to separate the two forms generically. The material was not in a sufficiently good state of preservation to allow of anything like a complete account of even the macroscopic anatomy, and I did not think it worth while to attempt any section cutting.

The alimentary canal presents the same characters originally described by Perrier* in *Pontoscolex* (*Urochæta*) *corethrurus*. The large gizzard is situated anteriorly, though I have not been able to fix precisely the segment or segments which it occupies. On each side of the gizzard is a large coiled "glande à mucosité." Schmarda has mentioned the fact that the œsophagus is furnished with "4 braune birnförmige Organe," which I take to be the calciferous glands or "glands of Morren" as they are sometimes called. I count, however, six of them, *i. e.* three pairs, as in *Pontoscolex corethrurus*.

Behind the gizzard are four stout mesenteries.

Behind these again lie two pairs of hearts.

Of the genital organs only the spermathecæ and the sperm-sacs were visible. I only found two pairs of spermathecæ, which lie behind the gizzard in the segment bounded by the two last thick mesenteries. Their form (see fig. 6) is rather different from that of the spermathecæ in *Pontoscolex corethrurus*. Each consists of a reniform pouch connected with a long duct which leads to the exterior. The sperm-sacs are tongue-shaped organs, as in *Pontoscolex corethrurus*.

In the posterior region of the body the "pyriform vesicles" characteristic of *Pontoscolex* were present.

(8) **Diachæta littoralis**, sp. n.
(Pl. VII. figs. 4 and 5.)

Pontoscolex arenicola, Schmarda, Neue wirbell. Thiere, Bd. i. Hälfte ii. p. 11 (in part).

Pontoscolex arenicola, Vaillant, Annelés, p. 198 (in part).

This worm, like *Diachæta Thomasii*†, has eight setæ in each segment, which alternate in position upon successive segments from the very first; and, as in that species, the setæ

* "Études sur l'organisation des Lombriciens terrestres, Anatomie des *Urochæta*," Arch. Zool. Exp. t. iii. (1874) p. 331.

† Benham, "Studies on Earthworms, No. II.," Quart. Journ. Micr. Sci. vol. xxvii. p. 89.

upon a given segment are separated from each other by wide intervals.

The setæ upon the general body-surface are not ornamented, which is a further point of resemblance to *Diachæta Thomasii*; but they were in a few cases unmistakably bifid, as in *Pontoscolex corethrurus*. It is seldom that the free extremity of the setæ in either of these species shows the bifidity clearly; they are generally apparently too much worn, and a faintly marked notch, readily passed over, alone indicates the cleft. It is quite possible, therefore, that *Pontoscolex arenicola* and *Diachæta Thomasii* may really possess the same notched setæ which Perrier first described and figured for "*Urochæta corethrura*." The setæ upon the clitellar segments are larger than some of the others and are distinctly ornamented with a series of crescentic ridges limited to the distal part of the seta. This particular form of seta is very characteristic of the Geoscolecidæ, particularly upon the clitellum, and the fact that similar setæ occur in *Criodrilus* is a strong argument for regarding that genus as being related to this family. Benham makes no remark about the clitellar setæ of *Diachæta Thomasii*. I may mention that this peculiar ornamentation of the setæ in the Geoscolecidæ often requires some looking for; it is not always very strongly marked.

As in the last species, there is no prostomium.

The clitellum is extensive, occupying segments xvi.–xxxi. Schmarda has mentioned that the clitellum sometimes consists of fifteen rings, commencing with the fifteenth.

The nephridia are furnished with those peculiar cup-like bodies at their termination which Perrier first described in *Pontoscolex corethrurus* and regarded as sphincters for the closure of the nephridial pore.

The spermathecæ (figs. 4, 5) are exceedingly long thin sacs, hardly, if at all, dilated at the blind extremity, where the semen is stored. There are here again only two pairs; each measures about 5 millim. in length, which is half the circumference of the worm in the region where they occur.

The mucous gland, gizzard, and thick mesenteries appear to be as in the last species.

"*Hypogæon orthostichon*," Schmarda.

This species clearly belongs to the family Cryptodrilidæ, which comprises the majority of the Australian earthworms: it is not a characteristic family in New Zealand—at present

Rhododrilus minutus * is the only member of the family known from that country; but I have specimens of another (undescribed) species, and if Captain Hutton is right † in referring his *Lumbricus lævis* and *L. uliginosus* to Perrier's genus *Digaster*, we have a third Cryptodrilid genus in New Zealand. "*Hypogæon orthostichon*" is not referable to either *Rhododrilus* or *Cryptodrilus*. It seems nearest perhaps to Fletcher's ‡ *Notoscolex* (=*Megascolides*, M'Coy). I am not at all certain that it belongs to that genus, for the definition given by Fletcher is not at all satisfactory; indeed the discrimination of the genera of Cryptodrilidæ is unquestionably the most difficult part of the classification of the Oligochæta.

As I do not wish, pending a revision of the Cryptodrilidæ, to add unnecessarily a new generic name, I shall describe Schmarda's species as

(9) **Megascolides orthostichon** (Schm.).

Hypogæon orthostichon, Schmarda, Neue wirbell. Thiere, Bd. i. Hälfte ii. p. 12.

I do not attempt to give here anything more than the most obvious characters, as I could only dissect one specimen, which I have been careful to injure as little as possible.

The setæ are in eight equidistant rows.

The clitellum is a complete girdle, and occupies segments xiv.–xvii. inclusive.

The male pores are upon segment xviii.; there appear to be no genital papillæ developed in their neighbourhood or anywhere else upon the body; the male pores correspond in position to the ventralmost setæ.

The gizzard is in segment v.

The nephridia are apparently of the "diffuse" type; they were not at all obvious.

The sperm-sacs are in segments x., xi., xii.

The ovaries are in segment xiii. The receptacula ovorum are present and occupy the usual position in segment xiv.

The atria are short and tubular in form; the chief part of the atrium is a white glandular tube which communicates with the exterior by a very short muscular duct. There appear to be no penial setæ.

* "On the Oligochætous Fauna of New Zealand, with Preliminary Descriptions of new Species," P. Z. S. 1889, p. 380.

† "Synopsis of the Genera of Earthworms," New Zeal. Journ. Sci. vol. i. p. 586.

‡ "Notes on Australian Earthworms," Proc. Linn. Soc. N. S. W. 1886.

The spermathecæ are two pairs and lie in segments viii. and ix. Each has a small diverticulum, pyriform in shape, like the main pouch.

(10) Perichæta vitiensis, sp. n.

The collection contained a single specimen of a *Perichæta* bearing the label "*Hypogæon*, sp. aff. *Hyp. orthostichon*, Schm. Viti Ins." It measures 75 millim. and consists of about seventy segments. The colour of the preserved specimen is a brownish yellow, grey upon the clitellum. The setæ are borne upon a very distinct ridge upon the middle of each segment. The clitellum occupies segments xiv.-xvi., ending a little way in front of the posterior border of the sixteenth segment. There are no setæ upon the clitellum. The male pores are transversely elongated, somewhat curved, slits lying upon two glandular-looking areas upon the eighteenth segment; between the two pores are about six setæ. The two pores are 3 millim. apart. The dorsal pores begin between segments xi./xii. The spermathecal pores (one pair) lie between segments vii./viii. on a line with the male pores. The oviducal pore is single and median upon segment xiv.

The gizzard lies in segments ix., x., the septum dividing those segments being absent. From the septum which bounds the gizzard anteriorly a number of muscular bands are given off which are attached to the dorsal parietes. There is only one very clearly defined septum in front of this one; behind the gizzard are four rather thickened septa. The large intestine commences in the fifteenth segment, and there are a pair of cæca not quite in the usual position; they appear to belong to segment xxiv. The dorsal vessel is single, and from about the thirtieth segment there are well-developed septal glands arising from the posterior septum of the segments, and in many cases forming a continuous mass lying above the dorsal vessel.

The sperm-sacs are in segments xi., xii.; each sperm-sac sends up a narrow tubular process which approaches its fellow in the middle dorsal line; the arrangement in fact recalls that found in *Perichæta Vaillanti*, where, however, the processes become fused, thus forming an arch round the intestine. I found one pair of testes in segment xi. attached to the front wall of the segment. The funnels of the vasa deferentia, of which there are also only a single pair, open in the neighbourhood of the testes; the septum dividing segments x./xi. seems to be made up of two layers, between which the funnel

lies; but as the specimen is a unique one, I am not able to settle the position of the funnel quite definitely, as it would be probably necessary to cut sections. The main fact, however, to which attention is called is the occurrence of only *one* pair of testes and one pair of funnels. I believe that in all *Perichætæ* hitherto described there are two pairs.

The atria are very compact and lie in segments xvii.–xix.: the horseshoe-shaped duct, which arises from the middle of the gland, is at first tolerably wide; just before the external opening it becomes exceedingly narrow and opens through a small globular sac on to the exterior.

The ovaries are in the thirteenth segment. The single pair of spermathecæ lie in the eighth segment; each has a single diverticulum, of a chalky-white colour owing to the contained sperm.

The only species of *Perichæta* with one pair of spermathecæ are *Perichæta elongata*, *P. quadragenaria*, and *P. sangirensis*; but *P. vitiensis* differs from all of these in the possession of but a single pair of testes and vas deferens funnels. Is it identical with Grube's *P. subquadrangulus*, which also comes from Viti? In this case, as with most of Grube's species, it is impossible to distinguish the species from his data.

(11) Acanthodrilus Schmardæ.

The single specimen of this species was found in fresh water at Rockhampton (? in Queensland).

It measures about 60 millim. in length by 5 millim. in breadth. The clitellum occupies segments xii.–xvii., and is undeveloped ventrally; the grooves between the clitellar segments are very evident; dorsal pores are present, but I could not ascertain where they commenced. Segments iii.–x. are annulate, the middle segments showing three annuli. On segments xvii. and xix. are the atrial pores, of which the anterior marks the ventral edge of the clitellum, and between segments viii/ix. a pair of spermathecal pores.

The worm being much contracted and the internal organs softened I am not able to say so much as I could wish about the anatomy of the worm. The notes that I am able to give, however, are quite sufficient to distinguish the species. The dorsal vessel is single; the nephridia are paired structures. A gizzard is present, but I am not certain which segment it occupies; after the gizzard come five thick mesenteries.

The only organs of which I am able to give an adequate account, and they are fortunately the most important, are the spermathecæ and the atria.

The atria are two pairs lying in segments xvii. and xix. respectively; the anterior pair are much the larger; both are coiled tubular glands and both are furnished with penial setæ. The anterior larger atria are furnished with five of these setæ, the posterior smaller pair have only two. This was only the case, however, on one side of the body; on the right side there were only two to each atrium. They are curved in form and show a transverse striation such as is usually found in large setæ up to nearly the free tip. The free extremity of the setæ is not ornamented in any way.

There are apparently two pairs of spermathecæ. In describing the external characters I have referred to the external aperture of the second pair, which are considerably the larger. Supposing that during copulation the worms lie in opposite directions, as is the case with *Lumbricus*, the larger pair of spermathecæ would correspond to the larger pair of atria. Whether the difference in size is a question of maturity or indicates a commencing disappearance of one pair of atria and of the spermathecæ corresponding to them I am unable to conjecture. The larger spermatheca showed a protuberance on the inner side near to its external aperture; this I suppose to be a diverticulum. Behind the second pair of spermathecæ is a pair of oval glands of the same appearance but smaller than the spermatheca. Between the two glands was a sac containing one or two copulatory setæ; these are smaller than the penial setæ and of a somewhat different form, but resemble them in being unornamented at the tip. Behind this pair of glands is another pair apparently also furnished with penial setæ; but I am not certain as to this point or as to whether they lie in the same segment or in the next. Structures similar to these have been described in other species of *Acanthodrilus*—for instance in *A. Layardi**.

There are now four or five *aquatic* Acanthodrilids known.

EXPLANATION OF PLATE VII.

Fig. 1. Posterior extremity of *Anteus heterostichon*, to show the divergence of the setæ. *s*, ventral, *s'*, dorsal setæ; *n*, nephridiopores; *a*, anus.

Fig. 2. Genital segments of *Geoscolex maximus*. *D.V.*, dorsal blood-vessel; H, "heart" connecting dorsal with ventral blood-vessel; *As*, œsophagus; *Ca*, calciferous gland; *V.S.*, sperm-sac bent upon itself; *Vd.*, vas deferens; *At.*, atrium. The organs of the left side only are shown.

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* F. E. Beddard, "Note on the Structure of a large Species of Earthworm from New Caledonia," P. Z. S. 1886, p. 173.

Fig. 3. Posterior end of body of *Pontoscolex arenicola*. *n*, nephridiopores; *A*, anus; *a*, "growing region" figured by Schmarda as clitellum.

Fig. 4. Extremity of spermatheca of *Diachæta littoralis*. *a*, large peritoneal cells.

Fig. 5. A spermatheca of the same species.

Fig. 6. A spermatheca of *Pontoscolex arenicola*. *sp.*, pouch communicating with exterior by long duct.

Fig. 7. Setæ of *Anteus heterostichon*. *a*, clitellar seta; 7 *d*, its free extremity more highly magnified; *b*, one of the ordinary setæ drawn to same scale as *a*; *c*, extremity of this seta more highly magnified.

Fig. 8. Setæ of *Geoscolex maximus*. *a*, a seta from one of the terminal segments of the body; *b*, free extremity of one of the clitellar setæ.

Fig. 9. Ventral aspect of clitellar and neighbouring segments of *Megascolex cingulatus*, for explanation of which see text. The segments are numbered.

Fig. 10. *Megascolex cingulatus*. Spermatheca. *Sp.*, the main pouch of the spermatheca; *d*, diverticulum; *d'*, diverticula of this; *o*, external orifice.

Fig. 11. The smaller diverticula of one side of the same, more highly magnified.

Fig. 12. "Prostate" of the same, showing the duct given off from the anterior end.

Fig. 13. Penial seta of the same. *a*, a seta; *b*, the free extremity, more highly magnified.

XVIII.—*The* Lysianassides *of the* '*British Sessile-eyed Crustacea*,' *Bate and Westwood*. By Alfred O. Walker.

Having lately been enabled, by the courtesy of the British Museum authorities, to inspect the collection of Amphipoda presented by the late Mr. Spence Bate to that institution, I venture to lay the results, so far as the Lysianassidæ are concerned, before your readers.

The collection consists of one hundred and fourteen tubes, containing Amphipoda, Caprellida, and two species of *Pranica*. The specimens are in methylated spirits. All the names are in the handwriting of the late Mr. Spence Bate, and are those of species included in the 'Brit. Sess.-eyed Crust.;' but many of the species in that work are not to be found in the collection. Time and London fog did not permit me to examine more than the Lysianassidæ, and the two species afterwards noted. It must be understood that the examination had to be carried on without dissection; nevertheless in most cases I was able, by immersing the specimen in glycerine, to make out the details with sufficient accuracy. I take the specimens in the order and with the names given